Remarks

The amendment to the specification better describe figures 11 through 14. The amendments to the specification do not constitute new matter. The amendments to the claims better identify the scope of the present invention. Support for the claims can be found in the amendments to the specification above. Additionally, support for the amendments can also be found on page 10, lines 6-8; page 11, lines 11-12; page 13, lines 14-18; page 14, lines 15-16; page 16, lines 17-20; page 17, lines 10-11; page 19, lines 8-11; page 20, lines 1-2; page 22, lines 4-7; page 22 18-19; page 24, lines 19-22; page 25, lines 11-12; page 27, lines 19-22; page 28, lines 13-14; page 30, lines 18-21; page 31, lines 10-11; page 33, lines 14-17; page 34, lines 6-7; page 36, lines 13-16; page 37, lines 6-7; page 39, lines 12-15; page 40, lines 17-20; page 42, line 8; page 44, lines 22+; and page 45 lines 1-3.

Applicants thank Examiner Chapman for the interview of February 18, 2004. The amendments to the specification and claims are responsive to the discussions during the examiner's interview and the office action of October 24, 2003.

(1) Applicants continue to elect the claims examined with traverse for the reasons discussed in the applicants' amendments of July 30, 2003.

(2) The examiner's rejection of claims 22 and 58 under 35 USC 112, second paragraph.

The claims have been amended to overcome indefiniteness.

(3) The examiner's rejections of claims 1-7, 11-43 and 47-74 as being unpatentable over McEachern, et al., (5,526,694) in view of Straser, et al., (6.292.108) is respectfully traversed for the following reasons:

(a) The present invention is directed to instrumentation to monitor changing conditions in burning buildings leading to collapse. Irreversible damage is already assumed. The applicants' system includes specially designed instrumentation that is used to capture fire-induced vibrations at sampling rates of 250 samples per second to 1000 samples per second that are then filtered to provide significant structural responses below 25 Hz. and finally interpreted in the context of transient characteristics of the building. These transient characteristics, including resonant frequencies, provide measurable changes as a collapse mechanism develops and leads to the development of an index for tracking changes leading to collapse of a structure. The need for real-time assessment and evaluation is critical in the application of collapse monitoring during burn. This real-time assessment provides visual indicators as the structure burns and does not require extended

monitoring periods. Obviously, extend periods are not possible during conditions where a structure is on fire. The ability to detect zero-frequency response is imperative since collapse of a burning structure requires the ability to detect and track falling trajectories within the structure.

Damage detection based on changes in system identification parameters is well documented in the literature. *See* Farrar, Cr., An Overview of Modal-Based Damage Identification Methods, Proc. Of DAMAS, June 1997. A considerable number of attempts were made in the late 1990s to develop damage detection algorithms based on the premise that system parameters, being functions of the physical properties of the structures, change as changes in structural stiffness occur. Early work focused on examining changes in resonant frequencies and damping to detect damage in large civil structures (e.g. bridges). However, these parameters proved to be insensitive to lower levels of damage and did not provide clear indications of the location or extent of damage. A study completed by Dr. Duron on a steel stringer bridge in which significant damage was introduced, resulted in a negligible shift in resonant frequency. *See* Duron, A proposed Field Diagnostic Procedure for Steel Stringer Bridges, Proceedings, 2nd World Conference of Structural Control, Kyoto, Japan, June 1998. Based on this experience, and those reported in literature, use of ambient excitation for purposes of health

monitoring of structures is suspect. This is particularly true when monitoring system parameters that are insensitive to low levels of damage. Damage detection is difficult since low levels of damage can be masked in any structure, and although changes in resonant frequencies may be detected, the relationship to damage is unclear and requires significant insight into the structure itself.

(b) U.S. 5,526,694 to McEachern, et al., describe and claim an approach that is based on extended monitoring times (approaching 48 hours) in order to obtain sufficient data quality that can be used to examine structural resonant characteristics. <u>These results are used for damage detection</u>. While McEachern, et al., state that ambient responses in structures can be detected to below 10Hz, they utilize an accelerometer having capability to detect environmental vibrations over the 20 to 2000 Hz frequency range. Furthermore, McEachern, et al., discuss the removal of zero-frequency and near-zero frequency acceleration using any well-known algorithm. Therefore, McEachern, et al., provide minimal resolution of acceleration in the time domain due to the low sampling rate of 25 samples per second (as distinguished by our sampling rate discussed above) and the 10Hz frequency cutoff using an accelerometer that is able to reproduce vibrations in the 20-2000 Hz range. This approach cannot be utilized for real-time

structural collapse monitoring because McEachern, et al., at best, provide a vague indicator of the potential for change in a structure and require a 48 hour acquisition period for data in order to produce results. A significant difference also exists in the manner by which the McEachern, et al., device is attached at appropriate locations. McEachern requires that their device be attached at the highest point of the structure to better able to measure resonant frequencies. Our device does not have this requirement, as it is a device directed to an entirely different purpose, i.e. collapse detection.

(c) U.S. 6,292,108B1 to Straser, et al., is directed to a wireless monitoring system that can be installed in existing structures to measure acceleration responses during extreme events and for periodic health monitoring purposes. This patent extends prior art technology by incorporating wireless and MEM sensor technologies into a single package. The system provides near real-time condition assessment for "extreme events" and can also be used for periodic monitoring purposes. The system consists of a plurality of self-powered sensor units and a site master unit designed to capture the mechanical vibrations that are local to each installation. In their description of "extreme events," Straser, et al., refers to "natural disasters such as earthquakes, hurricanes, tornados and floods," and the term "near real-time" is defined in "tens of minutes."

The practical application of Straser, et al., requires that "a number of tasks and experiments… be done." Straser, et al., suggest that the number and location of sensors installed in a structure should be informed by a modal analysis or field test of the structure. "In practice, the preinstallation process may involve iterative testing, modeling and analysis." For monitoring extreme events such as an earthquake, Straser, et al., describe the need for quick damage estimates leading to a requirement that all system computations be performed within 5 to 10 minutes. Further, Straser, et al., suggests a strategy that focuses "on instrumenting the structure at every floor or at a minimum, every few floors." Straser, et al., goes on to say, "The implication is that the instrumentation should be spread throughout the structure to cover as many damage locations as possible." Straser, et al., discuss the device's expected performance in an extreme event in terms of the number of bits to be transmitted and the total time required to complete its operation. As described, the device would acquire 2 minutes of actual event response and would consume 14 minutes of acquisition, transmission and archival procedures. In summary, the device of Straser, et al., acquires response information after 16 minutes and requires an additional 4 minutes to complete pre-programmed analytical procedures. Therefore, Straser, et al., describe a device that requires an

estimated 20 minutes to complete a monitoring cycle. While Straser, et al., can make a sustainable argument towards the ability to make damage detection, it cannot operate to determine collapse mechanism under these time lapses. Effective implementation of Straser's device requires a prior knowledge of structural behavior, a number of strategically placed sensors inside the structure and indication of structural performance over a 20-minute interval. These requirements present limitations that would prohibit an effective application to collapse monitoring. Collapse monitoring must be based on in-situ response measurements from structures where entry is considered unsafe. Furthermore, collapse monitoring requires an end-to-end time between acquisition and completion of proposed analytical procedures to be on the order of 10 seconds or less. The Straser, et al., device cannot operate under these real time constraints. Thus, Straser, et al., cannot operate in real-time to detect collapse mechanisms.

(d) The combination of McEachern, et al., with Straser, et al., does not hold the applicants' claims obvious.

As discussed above, McEachern, et al., utilizes a wired damage detection device for detecting resonant frequencies based upon wind. The wired system includes an accelerometer. Straser, et al., utilize a wireless system that includes a plurality of miniature sensors such as accelerometers. This very first

distinction in the mode of operation cannot sustain the examiner's position that the devices as taught by McEachern et al and that of Straser et al are combinable. Neither McEachern, et al., nor Straser, et al., indicate desirability of such a modification. While Straser, et al., discuss the undesirability of cables (see column 1, lines 59+) this teaching alone cannot lead one of ordinary kill in the art to modify McEachern, et al., as doing so would render the McEachern, et al., device inoperable.

Discussed also is the fact that neither McEachern, et al., nor Straser, et al., operate in real time. McEachern, et al., requires several days' worth of data, while Straser, et al., requires approximately 20 minutes to obtain data. One of ordinary skill would not be motivated to modify McEachern, et al., with Straser, et al., as the manner of damage detection is significantly different in both devices. Modifying McEachern, et al., to incorporate the damage detection structural features of Straser et al would render McEachern, et al., inoperable.

It appears to be the examiner's contention that a piecemeal addition/substitution of McEachern, et al., with the structural elements taught by Straser, et al., is sufficient to teach the applicants' present invention. The mere existence of accelerometers in all three devices does not render the applicant's present invention obvious. Such an argument would

also lead one of ordinary skill to find Straser, et al., obvious over McEachern, et al.

The significant difference of the applicants' invention over that of the prior art is that applicants' system detects imminent collapse, in real time. Irreversible damage is assumed.

Even more significant is that one of ordinary skill would have never been able to deduce from the reference patents where on a structure to place the fire-induced vibration sensors.

It is for these reasons that McEachern, et al., and Straser et al., are not combinable, and even in the unlikely event that one of ordinary skill in the art would find these references so, one of ordinary skill in the art would not find the combination to read upon the applicants' present invention. It is the applicants' position that the claims of the present invention are allowable over the prior art of record, for the reasons stated above.

Please direct any questions or comments regarding any issues pertaining to this application to Abanti B. Singla, Esq., at (410) 964-9553.

Sincerely,

3-24-04
Date

Abanti B. Singla, Esq.
Registration No. 36,681